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Linking Groundwater Nitrate-N Concentrations to Management and Hydrological Changes in two Agricultural Catchments

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In order to minimize Nitrogen (N) transfer from groundwater to surface water in agricultural river catchments it is useful to understand how those transfer pathways may vary over time and space, and thus in their connection to nutrient sources and potential effects of temporal changes in water recharge and land management. In this paper we investigate the links between N sources, groundwater and surface water, as well as the implication of spatiotemporal variability for mitigation measures. We present three years of N concentrations in stream water (sub-hourly) and in groundwater (monthly) of different strata in four hillslopes in two ca 10 km2 Irish agricultural catchments with permeable soils. One catchment with arable land overlying slate bedrock and the other with intensively managed grassland on sandstone. Both catchments were dominated by delayed nutrient transfer pathways via groundwater. Relatively high concentrations of N were found in the groundwater of both catchments, attributed to leaching of surplus soil nitrate-N. The Grassland/sandstone catchment had locally higher nitrate-N concentrations in the groundwater with more spatiotemporal variability than in the groundwater of the Arable/Slate catchment. The N concentrations in the stream water of the Arable/Slate catchment were more directly reflected by groundwater conditions. In one hillslope the effects of pasture reseeding were observed by locally elevated N concentrations in the groundwater with a delay of ca five months. This was not reflected in the surface water despite groundwater dominating the contribution to stream water. In another hillslope N was naturally buffered in the near-stream zone, but this zone was bypassed with high nitrate-N content water from the uplands via tile-drains. The apparent spatiotemporal variability in N concentration highlights the need for insight into these differences when interpreting groundwater quality data from a limited number of sampling points and occasions. For effective characterization of nutrient transfer pathways in catchments with permeable soils we suggest including a chemical groundwater signature that represents the catchment for each geological strata.